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(11) EP 0 959 641 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.11.1999 Bulletin 1999/47

(51) Int. Cl.^{6}: **H04Q 11/04**

(21) Application number: 98401211.2

(22) Date of filing: 19.05.1998

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

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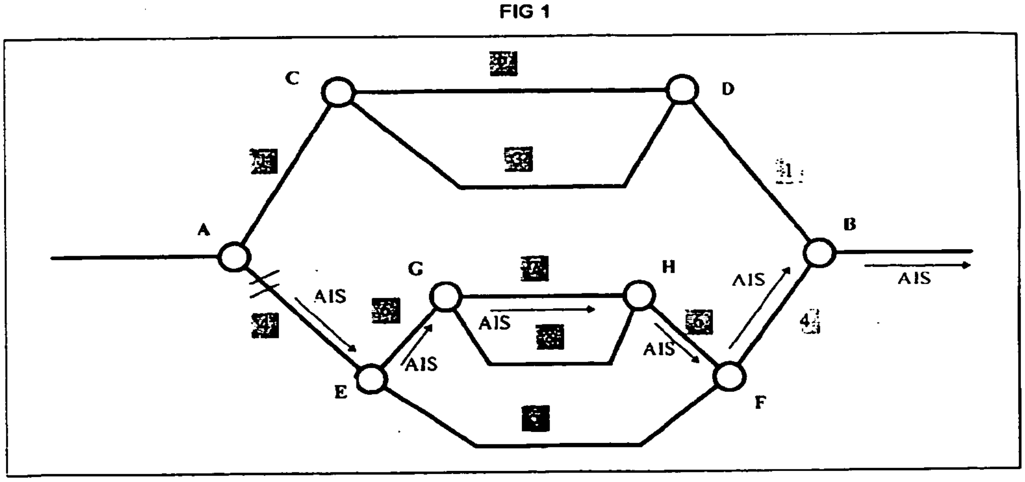
(54) Method for protection of ATM connections in a telecommunication network

(57) Method for protection of ATM connections in a telecommunication network comprising at least one protection domain which covers only a portion of a connection, each protection domain comprising a source node (A) and a peer sink node (B). Each source node and its peer sink node can be connected by at least two alternative connection portions (1, 4) and can switch over from one connection portion to the other. Any node of the network can send an alarm message (AIS) downstream a current way (AEG7HFB) and each node can memorise a failure connection status when it receives such an alarm message (AIS). Each sink node (H, F, B) which receives the alarm message (AIS) sends a switchover request message (SWRQ) to its peer source node (respectively G, E, A) to request a switchover which is executed if the peer source node has not memorised an alarm message. The sink node, switches over only if the peer source node has responded positively.

Application to ATM telecommunication network.

FIG 1



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Description

[0001] The invention concerns the protection of ATM connections, when the network comprises at least one protection domain which covers only a portion of a connection. Each protection domain comprises a first and a second access node. Each of these access nodes can switch over from a first to a second connection, in case of failure on the first connection. For the direction of transmission going from the first access node to the second access node, the first access node is called source node, and the second access node is called sink node.

[0002] Until now there is a protection method which is only applicable when the protection domain covers a complete connection from end to end. It is based on the AIS function (Alarm Indicator Signal) : AIS cells are sent downstream for informing downstream nodes about transmission failure. It uses a protocol called APS (Automatic Protection Switching). When a sink node receives an AIS cell, it sends a switchover request message to the source node with help of an APS cell. Then the source node and the sink nodes switch over.

[0003] When a protection domain covers only a portion of a connection, this method is not applicable because the sink node cannot distinguish whether the AIS cell originates from a node located before or after the source node.

[0004] The aim of the invention is to propose a method applicable when the network comprises at least one protection domain covering only a portion of a connection, without changing anything in the present definition of the AIS function, for simplicity and backward compatibility with the present state of the Art. According to the invention, the ATM connection protection is a separate problem from the OAM (Operation And Maintenance), and therefore it must be solved in a separate way. Since APS cells have been created specifically for this problem, the proposed method is based on the usage of such APS cells, and the AIS cells are used for triggering the APS mechanism.

[0005] According to the invention, a method for protection of ATM connections in a telecommunication network comprising at least one protection domain which covers only a portion of a connection, each protection domain comprising a source node and a peer sink node, each source node and its peer sink node being able to be connected by at least two alternative connection portions and being able to switch over from one connection portion to the other; any node of the network being able to send an alarm message downstream a current way and each node being able to memorise a failure connection status when it receives such an alarm message ;

characterised in that it comprises the following steps :

- in each sink node which receives the alarm message, sending a switchover request message to its peer source node to request a switchover which is executed only if the peer source node has not memorised an alarm message ;
- and then, in said sink node, switching over only if the peer source node has responded positively.

[0006] Preferably, it further consists in sending, from a sink node to a peer source node a confirm message to confirm that this sink node is switching over, and in switching over in the source node only if the source node receives the confirm message.

The **figure 1** shows an example of an ATM telecommunication network with nested protection domains.

The **figure 2** illustrates the claimed method by showing the transmission of messages in this example of ATM network when a transmission failure occurs.

[0007] In the example of **figure 1**, a connection is established between nodes A and B. Nodes A to H are able to perform switchover between elementary connection portions numbered from 1 to 8. There are protection domains which covers only a portion of the connection, and which are nested into other protection domains :

- Nodes C and D may be connected either by connection 2 or by connection 3 ;
- Nodes G and H may be connected either by connection 7 or by connection 8 ;
- Nodes E and F may be connected either by connection 6 (via G and H) or by connection 5 ;
- Nodes A and B may be connected either by connection 1 (via C and D) or by connection 4 (via E and F).

[0008] For instance, there is a failure on elementary connection portion 4 between A and E. Then, AIS cells are periodically generated either directly by E or by the first node on the elementary connection portion 4 (not shown on the figure). These AIS cells are received by all the nodes E, G, H, F and B, assumed that the active way is currently A-4-E-6-G-7-H-6-F-4-B. All these nodes memorise that the corresponding entering connection is in the AIS state, by memorising a connection failure status indicator. All these nodes retransmit the AIS cells downstream.

[0009] The nodes H, F and B are sink points of protection domains. Each of these sink nodes sends an APS message to its peer source node, upstream, respectively G, E and A, each sink node knowing the identity of its peer source node. Each APS message contains :

- SWRQ : request for switchover,

- #G, #E or #A: address of the destination node.

[0010] The nodes G, E and A answer either by accepting or refusing this switchover request :

- acceptance if the status of the connection entering this node indicates no failure, case of node A.
- refusal if the status of the connection entering this node indicates a failure, case of nodes G and E.

[0011] The source node may switch over as soon as it answers positively. Optionally, the source node may wait for a Confirm message, CF, sent from the sink node to the source node to indicate that the the sink node switches over and to trigger the switchover of the source node, for improving reliability of the method.

[0012] The **figure 2** illustrates the claimed method by showing the transmission of APS messages in this example of network when a transmission failure occurs. The node H sends a switchover request message (SWRQ, #G) to peer node G. This latter answers negatively (SWNOK, #H) and does not swich over, because it is in AIS state. This means that the failure occurred upstream. Then the node F sends a switchover request message (SWRQ, #E) to peer node E. This latter answers negatively (SWNOK, #F) and does not swich over, because it is in AIS state. This means that the failure occurred upstream. Then the node B sends a switchover request message (SWRQ, #A) to node A. This node A answers positively (SWOK, #B), because it is **not** in AIS state. Then the node B switches over and then sends a confirm message (SWCF, #A) to node A. Then this latter switches over.

[0013] One remarks that each sink node operates independently. They may operate quasi simultaneously. Only the nodes A and B perform a switchover.

[0014] The APS protocol must use the standby ATM route in order to check it before to perform switchover.

[0015] This solution has only advantages :

- It separates the problems of OAM and network protection, especially it needs no correlation between the concept of connection segment used for OAM purpose, and the concept of protection domains used for protection purpose, and therefore doesn't need the notion of embedded connection segments.
- Whatever the solution chosen for the AIS cells, modification of their definition or not, it is necessary to add a procedure based on APS cells in order to synchronise the switchover. So, basing the network protection on APS cells brings no additional complexity.
- This solution is backward compatible, since it needs no evolution of the present AIS cells and intermediate nodes.

Claims

1. Method for protection of ATM connections in a telecommunication network comprising at least one protection domain which covers only a portion of a connection, each protection domain comprising a source node (A) and a peer sink node (B), each source node and its peer sink node being able to be connected by at least two alternative connection portions (1, 4) and being able to switch over from one connection portion to the other ; any node of the network being able to send an alarm message (AIS) downstream a current way (AEG7HFB) and each node being able to memorise a failure connection status when it receives such an alarm message (AIS) ;
characterised in that it comprises the following steps :

    - in each sink node (H, F, B) which receives the alarm message (AIS), sending a switchover request message (SWRQ) to its peer source node (respectively G, E, A) to request a switchover which is executed only if the peer source node has not memorised an alarm message ;

    - and then, in said sink node, switching over only if the peer source node has responded positively.

2. Method according to claim 1, characterised in that it further consists in sending, from a sink node (B) to a peer source node (A) a confirm message (SWCF,#A) to confirm that this sink node (B) is switching over, and in switching over in the source node only if the source node receives the confirm message.

FIG 1

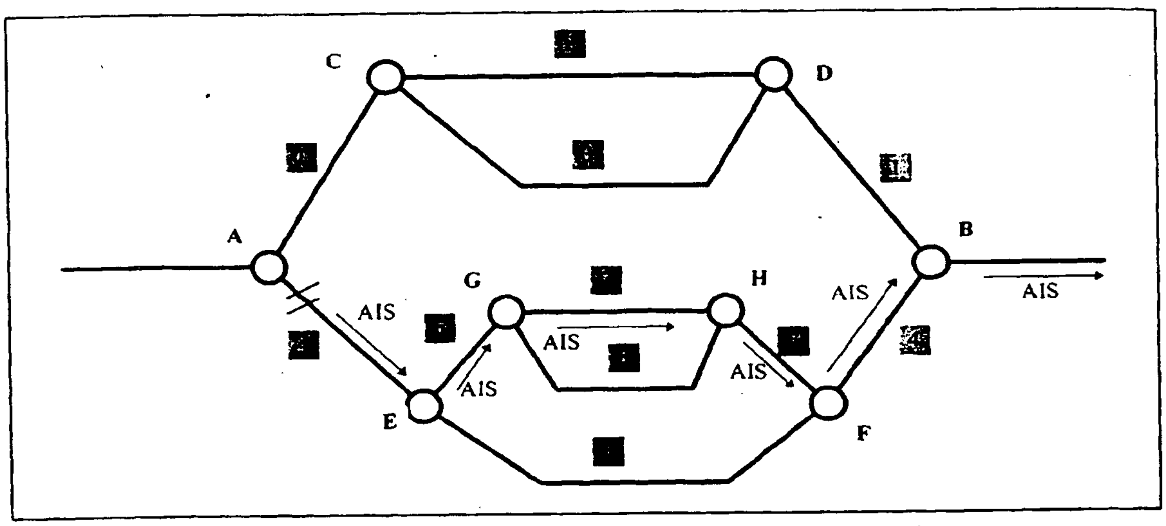
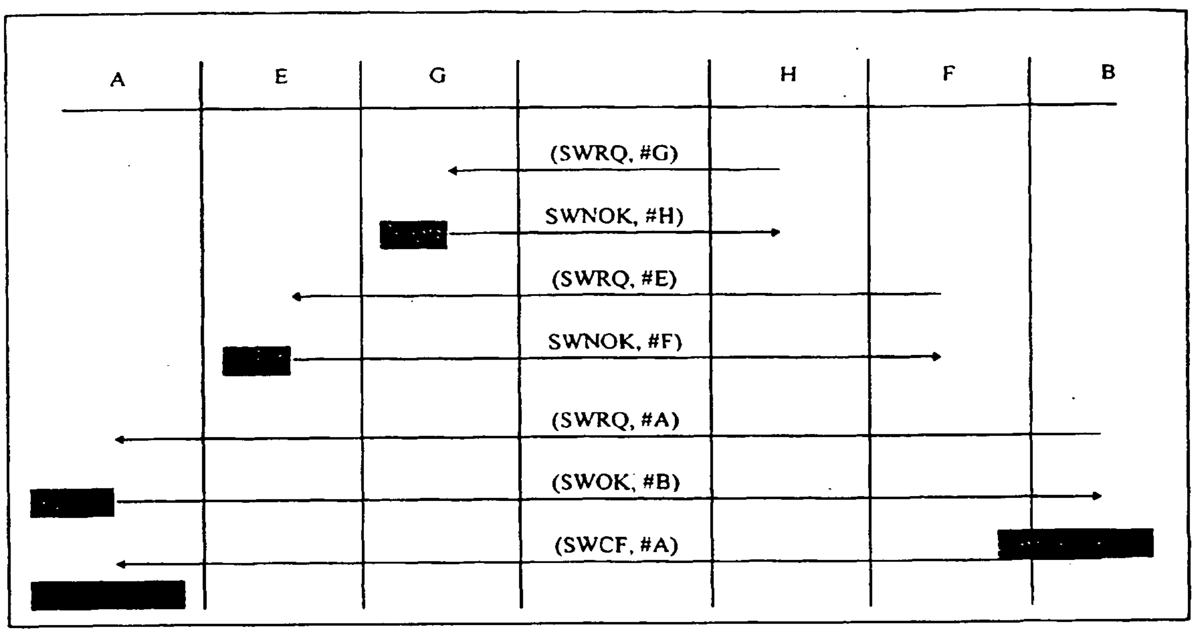


FIG 2



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EUROPEAN SEARCH REPORT

Application Number
EP 98 40 1211

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	SAITO H ET AL: "AN IMPROVED GUIDED RESTORATION ALGORITHM FOR ATM CROSSCONNECT NETWORKD" 1996 IEEE NETWORK OPERATIONS AND MANAGEMENT SYMPOSIUM (NOMS), KYOTO, APR. 15 - 19, 1996, vol. 1, no. SYMP. 5, 15 April 1996, pages 225-234, XP000641094 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS * page 226 - page 229 * ---	1,2	H04Q11/04
A	JONES C K ET AL: "A FAST ATM REROUTING ALGORTHM FOR NETWORKS WITH UNRELIABLE LINKS" SERVING HUMANITY THROUGH COMMUNICATIONS. SUPERCOMM/ICC, NEW ORLEANS, MAY 1 - 5, 1994, vol. 1, 1 May 1994, pages 91-95, XP000438889 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS ---	1,2	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16 November 1998	Staessen, B

CATEGORY OF CITED DOCUMENTS

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A	HIDEO TATSUNO ET AL: "HITLESS PATH PROTECTION SWITCHING TECHNIQUES FOR ATM NETWORKS" ELECTRONICS & COMMUNICATIONS IN JAPAN, PART I - COMMUNICATIONS, vol. 77, no. 8, 1 August 1994, pages 13-23, XP000485780 * paragraph 4.2 * -----	1,2	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)

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